



Standard Specification for Copper-Iron Alloy Plate, Sheet, Strip, and Rolled Bar¹

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1. Scope *

1.1 This specification covers Copper Alloy UNS Nos. C19200, C19400, C19500, and C19700² plate, sheet, strip, and rolled bar.

1.2 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 ASTM Standards:

B 193 Test Method for Resistivity of Electrical Conductor Materials²

B 248 Specification for General Requirements for Wrought Copper and Copper-Alloy Plate, Sheet, Strip, and Rolled Bar³

B 601 Practice for Temper Designations for Copper and Copper Alloys—Wrought and Cast³

B 846 Terminology for Copper and Copper Alloys³

E 8 Test Methods for Tension Testing of Metallic Materials⁴

E 54 Test Methods for Chemical Analysis of Special Brasses and Bronzes⁵

E 62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)⁵

E 75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys⁵

E 76 Test Methods for Chemical Analysis of Nickel-Copper Alloys⁵

E 112 Test Methods for Determining Average Grain Size⁴

E 478 Test Methods for Chemical Analysis of Copper Alloys⁶

E 527 Practice for Numbering Metals and Alloys (UNS)⁴

3. Terminology

3.1 *Definitions*—For definitions of terms related to copper and copper alloys, refer to Terminology B 846.

¹ This specification is under the jurisdiction of ASTM Committee B-5 on Copper and Copper Alloys and is the direct responsibility of Subcommittee B05.1 on Plate, Sheet, and Strip.

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² *Annual Book of ASTM Standards*, Vol 02.03.

³ *Annual Book of ASTM Standards*, Vol 02.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.01.

⁵ *Annual Book of ASTM Standards*, Vol 03.05.

⁶ *Annual Book of ASTM Standards*, Vol 03.06.

4. General Requirements

4.1 The following sections of Specification B 248 constitute a part of this specification:

4.1.1 Terminology,

4.1.2 Materials and Manufacture,

4.1.3 Workmanship, Finish, and Appearance,

4.1.4 Sampling,

4.1.5 Number of Tests and Retests,

4.1.6 Specimen Preparation,

4.1.7 Test Methods (except chemical analysis),

4.1.8 Significance of Numerical Limits,

4.1.9 Inspection,

4.1.10 Rejection and Reheating,

4.1.11 Certification,

4.1.12 Test Reports (Mill),

4.1.13 Packaging and Package Marking, and

4.1.14 Supplementary Requirements.

4.2 In addition, when a section with a title identical to that referenced in 4.1 appears in this specification, it contains additional requirements which supplement those appearing in Specification B 248.

5. Ordering Information

5.1 Contracts or purchase orders for product under this specification should include the following information:

5.1.1 ASTM designation and year of issue (for example B 465–XX),

5.1.2 Copper Alloy UNS No. designation (for example, C19200),

5.1.3 Temper (Section 8),

5.1.4 *Dimensions*—Thickness, width, length etc. (Section 11),

5.1.5 *Form*—Plate, sheet, strip, or rolled bar,

5.1.6 *How Furnished*—Coils (rolls), specific lengths or stock lengths, with or without ends,

5.1.7 *Quantity*—total weight each form, temper, and size, and

5.1.8 When material is purchased for agencies of the U.S. Government (Section 11).

5.2 The following options are available under this specification and should be specified in the contract or purchase order when required:

5.2.1 *Type of Edge*—Slit, sheared, sawed, square corners,

*A Summary of Changes section appears at the end of this standard.

round corners, rounded edges, or full rounded edges,

5.2.2 Width and straightness tolerances (appropriate table in Specification B 248),

5.2.3 Heat identification or traceability details,

5.2.4 Certification, and

5.2.5 Mill test report.

6. Materials and Manufacture

6.1 Material:

6.1.1 The material of manufacture shall be a cast bar, cake, slab, and so forth of Copper Alloy UNS No. C19200, C19400, C19500, or C19700, as specified in the ordering information, and of such purity and soundness as to be suitable for processing into the products prescribed herein.

6.1.2 In the event heat identification or traceability is required, the purchaser shall specify the details desired.

NOTE 1—Because of the discontinuous nature of the processing of castings into wrought products, it is not practical to identify a specific casting analysis with a specific quantity of finished product.

6.2 Manufacture:

6.2.1 The product shall be manufactured by such hot-working, cold-working, and annealing processes as to produce a uniform wrought structure in the finished product.

6.2.2 The product shall be hot- or cold-worked to the finished size, and subsequently annealed, when required, to meet the temper properties specified.

6.2.3 Edges—Slit edges shall be furnished unless otherwise specified in the contract or purchase order.

7. Chemical Composition

7.1 The material shall conform to the requirements prescribed in Table 1 for the Copper Alloy UNS No. designation specified in the ordering information.

7.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer and the purchaser.

7.2 Copper, when specified as the remainder, may be taken as the difference between the sum of results for specified elements and 100 %.

7.3 When all elements listed in Table 1 for the designated alloy are determined, the sum of results shall be 99.8 % minimum.

8. Temper

8.1 As defined in Practice B 601, products shall be produced in tempers O60 (soft annealed), O61 (annealed), O50 (light annealed), O82 (annealed to temper - 1/2 hard), H01 (1/4hard), H02 (1/2 hard), H03 (3/4 hard), H04 (hard), H06 (extra hard), H08 (spring), H10 (extra spring), and H14 (super spring).

NOTE 2—The purchaser should confer with the manufacturer or supplier for the availability of product in a specific alloy, temper, and form, since all tempers are subject to manufacturing limitations.

NOTE 3—Properties of special tempers not listed in this specification are subject to agreement between the manufacturer and purchaser.

9. Grain Size for Annealed Tempers

9.1 Grain Size—No grain size requirements have been established for tempers O50, O60, and O61; however, the product material shall be fully recrystallized when examined in accordance with Test Methods E 112.

10. Physical Property Requirements

10.1 Electrical Resistivity Requirement:

10.1.1 The product furnished shall conform to the requirements of Table 2 for the Copper UNS No. designation and temper specified in the ordering information when determined in accordance with Test Method B 193.

10.1.1.1 Products produced in temper O60 from Copper Alloy UNS No. C19400 are not required to conform with the resistivity requirement of Table 2.

11. Mechanical Property Requirements

11.1 Tensile Requirements:

11.1.1 The product furnished shall conform to the requirements prescribed in Table 3 for the Copper Alloy UNS No. designation and temper specified in the ordering information when subjected to test in accordance with Test Methods E 8.

11.1.1.1 Refer to Table 4 for SI equivalents for tensile strength.

11.2 Rockwell Hardness—The approximate Rockwell values given in Table 3 are for general information and assistance in testing and shall not be used as a basis for rejection.

NOTE 4—The Rockwell hardness test offers a quick and convenient method of checking for general conformity to the specification requirements for temper and tensile strength.

TABLE 1 Chemical Requirements

Element	Composition, %			
	Copper Alloy UNS No.			
	C19200	C19400	C19500	C19700
Copper	98.5	97.0	96.0	remainder
Iron	0.8 to 1.2	2.1 to 2.6	1.0 to 2.0	0.30–1.2
Phosphorus	0.01 to 0.04	0.015 to 0.15	0.01 to 0.35	0.10–0.40
Zinc	0.20 max	0.05 to 0.20	0.20 max	0.20 max
Lead, max	0.03	0.03	0.02	0.05
Tin	...	...	0.10 to 1.0	0.20 max
Cobalt	...	...	0.3 to 1.3	0.05 max
Aluminum	...	...	0.02 max	...
Magnesium	...	...	...	0.01–0.20
Nickel, max	...	...	...	0.05
Manganese, max	...	...	...	0.05

TABLE 2 Electrical Resistivity Requirements

Temper	Resistivity ^A at 20°C (68°F) Ω · g/m ²			
	Copper Alloy UNS No.			
	C19200	C19400	C19500	C19700
Annealed O50, O60, O61, and O62	0.235 81 max	0.383 26–0.204 37	0.305 65 max	0.191 60 max
Rolled H01, H02, H03, H04, H06, H08, H10, and H14	0.255 47 max	0.255 47 max	0.340 62 max	0.199 06 max
Rolled strip rework H04		0.255 47 max		

^ASee Appendix X2 for conductivity equivalents.

TABLE 3 Mechanical Requirements

Temper Designation (B 601)		Tensile Strength, ksi ^A	Approximate Rockwell Hardness			
Designation	Name		B Scale		Superficial 30T	
			0.020 in. (0.508 mm) to 0.036 in. (0.914 mm) Incl	Over 0.036 in. (0.914 mm)	0.012 in. (0.305 mm) to 0.028 in. (0.711 mm) Incl	Over 0.028 in. (0.711 mm)
Copper Alloy UNS No. C19200						
O61	annealed	40–50	...	...	...	...
H01	¼ hard	45–55	...	...	...	...
H02	½ hard	52–62	53–69	...	53–66	...
H04	hard	60–70	68–74	...	66–71	...
H06	extra hard	67–74	71–75	...	69–73	...
H08	spring	70–78	73–76	...	69–74	...
H10	extra spring	74–80	73–76	...	69–74	...
Copper Alloy UNS No. C19400						
O60	soft anneal	40–50	...	...	...	...
O50	light anneal	45–55	...	...	...	...
O82	annealed to temper—½hard	53–63	...	...	...	...
H02	½ hard	53–63	49–69	57–70	52–63	51–66
H04	hard	60–70	67–73	68–76	61–68	64–69
H06	extra hard	67–73	72–75	75–77	67–69	68–69
H08	spring	70–76	73–78	76–79	68–69	69–72
H10	extra spring	73–80	75–79	77–80	69–70	69–72
H14	super spring	80 min	...	...	70 min	...
Copper Alloy UNS No. 19500						
O60	soft anneal	50–60	...	...	...	...
H01	¼ hard	60–72	63–79	...	61–71	...
H02	½ hard	68–78	76–81	...	69–73	...
H03	¾ hard	75–85	80–83	...	72–74	...
H04	hard	82–90	82–85	...	73–75	...
H08	spring	88–97	84–87	...	74–77	...
Copper Alloy UNS No. C19700						
O60	soft anneal	43–53	...	...	...	...
H02	½ hard	53–63	62–71	...	62–68	...
H04	hard	60–70	66–73	...	65–70	...
H06	extra hard	67–73	70–75	...	68–71	...
H08	spring	70–76	71–77	...	69–72	...
H10	extra spring	73–80	72–78	...	70–74	...

^AThe tensile strength conversions to SI units are given in Table 4 (ksi = 1000 psi).

12. Purchases for U.S. Government Agencies

12.1 When identified in the contract or purchase order, as product purchased for agencies of the U.S. Government, it shall conform to the special government requirements stipulated in the Supplemental Requirements given in Specification B 248.

13. Dimensions, Mass, and Permissible Variations

13.1 The product furnished under this specification shall conform to the following tables in the Dimensions, Mass, and Permissible Variations section of Specification B 248:

13.1.1 Thickness.

13.1.1.1 *Tolerances*—Table 1.

13.1.2 Width.

13.1.2.1 *Tolerances for Slit Metal and Slit Metal with Rolled Edges*—Table 2.

13.1.2.2 *Tolerances for Square-Sheared Metal*—Table 5.

13.1.2.3 *Tolerances for Sawed Metal*—Table 6.

13.1.3 Length:

13.1.3.1 *Tolerances for Straight Lengths*—Table 7.

13.1.3.2 *Schedule of Minimum Lengths with Ends*—Table 8.

13.1.3.3 *Tolerances for Squared Sheared Metal*—Table 9.

TABLE 4 Metric Equivalents for Tensile Strength

ksi	MPa ^A
40	275
43	295
45	310
47	325
50	345
52	360
53	365
55	380
57	395
60	415
62	425
63	435
67	460
70	485
73	505
74	510
76	525
80	550

^ASee Appendix.

13.1.3.4 *Tolerances for Sawed Metal*—Table 10.

13.1.4 *Straightness*.

13.1.4.1 *Tolerance for Slit Metal or Slit Metal Either Straightened or Edge Rolled*—Table 11.

13.1.4.2 *Tolerances for Squared Sheared Metal*—Table 12.

13.1.4.3 *Tolerances for Sawed Metal*—Table 13.

13.1.5 *Edges*.

13.1.5.1 *Tolerances for Radius of Square Edges*—Table 14.

13.1.5.2 *Tolerances for Radius of Round Corners*—Table 15.

13.1.5.3 *Tolerances for Radius of Round Edges*—Table 16.

13.1.5.4 *Tolerances for Radius of Full Rounded Edges*—Table 17.

14. Test Methods

14.1 *Chemical Analysis:*

14.1.1 Chemical composition shall be determined, in case of disagreement, by the following appropriate method:

Element	Test Method
Aluminum	E 478
Copper	E 478
Cobalt	E 75
Iron	E 76
Lead	E 478 (AA)
Manganese	E 62
Nickel	E 478 (Photometric)
Phosphorus	E 62
Tin	E 478 (Photometric)
Zinc	E 478 (AA)

14.1.1.1 Since no recognized test method is known to be published, the determination of magnesium shall be subject to agreement between the manufacturer or supplier and the purchaser.

14.1.2 Test method(s) used for the determination of element(s) required by contractual or purchase order agreement shall be as agreed upon between the manufacturer and the purchaser.

14.2 Test methods for all other properties are given in Specification B 248.

15. Keywords

15.1 copper-iron alloy plate; copper-iron alloy rolled bar; copper-iron alloy sheet; copper-iron alloy strip

APPENDIXES

(Nonmandatory Information)

X1. METRIC EQUIVALENTS

X1.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = \text{kg} \cdot \text{m}/\text{s}^2$). The derived SI unit for pressure or

stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$, the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^2 and N/mm^2 .

X2. CONDUCTIVITY, % IACS, EQUIVALENTS

TABLE X2.1 Conductivity, % IACS, Equivalents

Resistivity	Conductivity, % IACS
0.341 75	45
0.307 58	50
0.255 47	60
0.235 81	65
0.218 97	70
0.204 37	75
0.199 06	77
0.191 60	80

SUMMARY OF CHANGES

Committee B05.01 has identified the location of selected changes to this standard since the last issue of B 465 – 93 that may impact the use of this standard.

(1) *General Requirements*—This section was expanded to identify the sections of Specification B 248 that apply to this specification.

(2) *Ordering Information*—This section was revised to better describe the product ordered.

(3) The following new sections were added:

Materials and Manufacture.

Grain Size for Annealed Tempers.

Purchases for U.S. Government.

Test Methods, which identifies individual test method for each specified element of composition.

(4) Resistivity values were changed in Table 2.

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